# Clinical Assessment of a New Neuromuscular Transmission Monitoring System (ACCELOGRAPH®)

## – A Comparison with the Conventional Method –

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(Key words: acceleration transducer, neuromuscular transmission monitoring, accelograph)

The Accerograph® is one of the latest development in the field of neuromuscular transmission monitoring[1] (fig. 1). This system is based on the use of a miniature accelration transducer that is fastened to the thumb. Stimulation is performed via the ulnar nerve at the wrist in the same way as with the conventional method. However, it is not necessary to fix the thumb itself or consider the preload in the clinical setting. The thumb can remain free when this new equipment is applied, and consequently it is much easier to handle than the conventional force-measurement method.

This study assessed the reliability of this method in clinical setting, in comparison with the force-measurement method (Myograph 2000®).

### Materials and Methods

The subjects were 15 adult patients (ASA class I–II, Age 40.1 ± 3.4, Body weight 56.4 ± 4.6 kg) who underwent elective gynecologic and gastoenterologic operation. No patient had neuromuscular disease nor received any drugs that would affect neuromuscular function. No patient had abnormalities in the hand and fingers. Anesthesia was induced with 3–5 mg/kg thiopental (i.v.) and maintained with 50% nitrous oxide in oxygen and enflurane 1.5–2.0% inspired concentration. Tracheal intubation was carried out following intravenous administration of 1.0 mg/kg succinylcholine. For further paral-

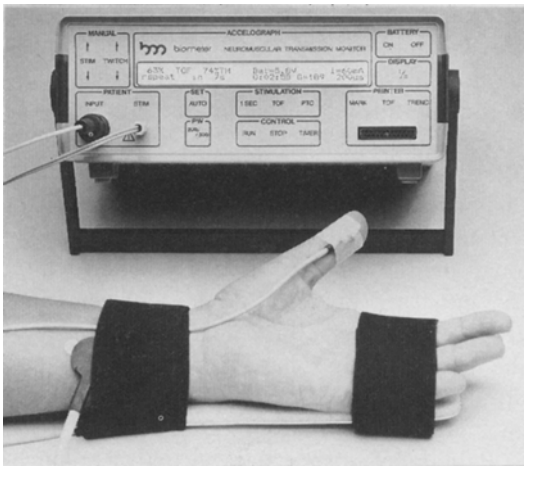

**Fig. 1.** New monitoring system for neuromuscular transmission (Accelograph®). This system is based on the use of a miniature acceleration transducer, simply fastened to the thumb with tape.

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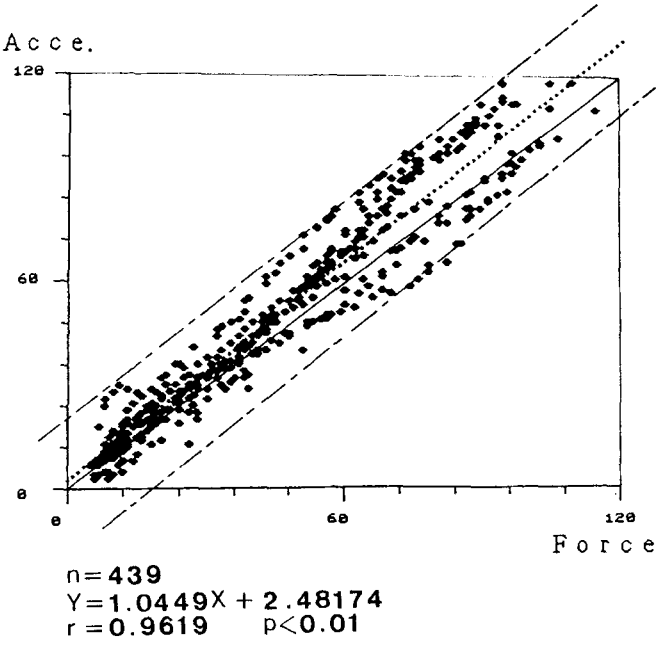


**Fig. 2.** Comparison of twitch responses (% of control height) measured by Accelograph® and Myograph 2000®. (——: line of identity, -----: line of regression, ———: 95% confidence limits for prediction of individual values measured by the acceleration method.)

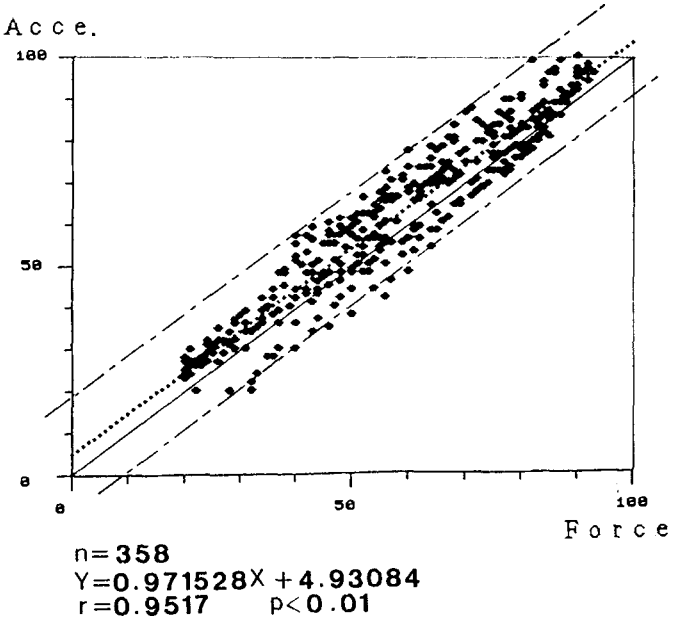


**Fig. 3.** Comparison of TOF ratios (%) measured by Accelograph® and Myograph 2000®. (——: line of identity, -----: line of regression, ———: 95% confidence limits for prediction of individual values measured by the acceleration method.)

ysis, pancuronium (0.08–0.1 mg/kg, i.v.) was used. Prior to induction of anesthesia, the Accelograph was attached to the thumb of the left hand with a tape as shown in figure 1 and Myograph 2000® was put on the right hand in 8 subjects, and the hands were reverse in the other 7 subjects. Following induction of anesthesia, the ulnar nerves of both sides were electrically stimulated simultaneously through cutaneous electrodes connected to the stimulators of the respective instruments. After supramaximal nerve stimulation was achieved, the control twitch response was set at 100% in both instruments. Then, a muscle relaxant (pancuronium, 0.08–0.1 mg/kg) was administered. Posttetanic

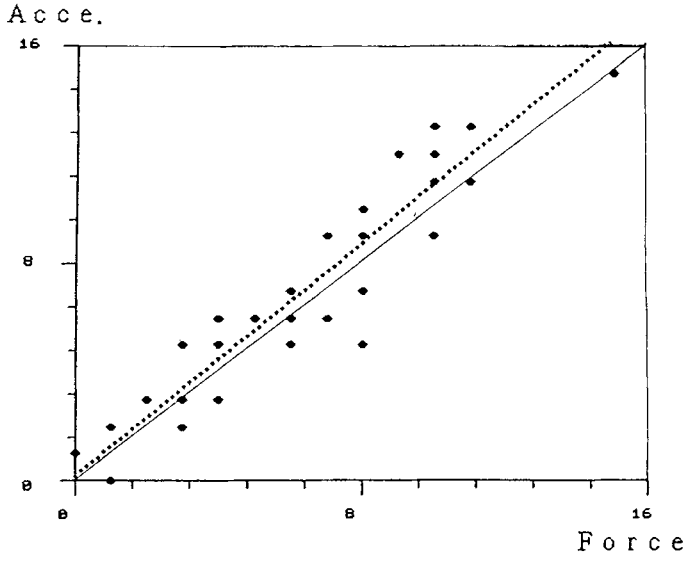


**Fig. 4.** Comparison of posttetanic counts[2] measured by Accelograph® and Myograph 2000®.

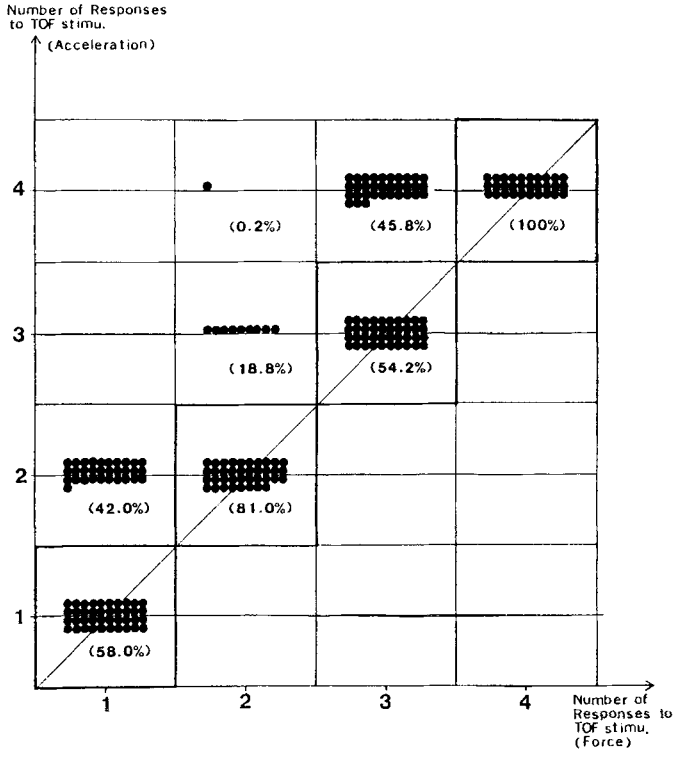


**Fig. 5.** Comparison of the number of detectable responses to TOF stimulation measured by Accelograph® and Myograph 2000®. When only one response to TOF stimulation was detected by the force transducer, one response was detected in 58% of trials and the two responses were detected in 42% by the acceleration. When the two responses were detected by Myograph, two responses were detected in 81.0% three responses in 18.8% and four responses in 0.2% by Accelograph®. The three responses were detected by the force method, while the acceleration method detected three responses in 54% and four responses in 45.8% of trials.

count[2] (the number of posttetanic twitch responses), number of responses to TOF[3] (Train-of-Four) stimulation, twitch response (% of control twitch height), and the TOF ratio were simultaneously measured by both instruments during intense blockade (the period of complete block with no response to twitch and TOF stimulation), surgical blockade (the period of 2 or 3 responses to TOF stimulation), and the recovery phase. The adduction acceleration of the thumb twitch was measured with a acceleration transducer attached to the thumb by the Accelograph®, and the adduction force of the thumb twitch was measured with a force transducer by the Myograph 2000®. During these measurements, the skin temperature of both arms was monitored continuously through a subdermal thermistor and kept warm and equal on the both sides. The two methods were compared using simple linear regression and correlaltion analysis.

## Results

With the two methods, there were significant correlations between the twitch heights (fig. 2) between the TOF ratios (fig. 3) and between the posttetanic counts (fig. 4). The number of responses to TOF stimulation in the condition of clinically sufficient neuromuscular blockade to facilitate surgical maneuvers is shown in figure 5.

## Discussion

According to Newton's equation, force acting on mass it accelerates it in the direction of the force. The magnitude of acceleration is proportional to the force and inversely proportional to the mass. In the following equation, $F=m \times \alpha$ (force=mass × acceleration), "m" is the mass of a body and "F" is the force acting on the body, and "$\alpha$" is the acceleration. If this formula is applied to the acceleration motion of thumb is caused by electric stimulation of the ulnar nerve, it can be represented as follows:

- F for the adductive force of a thumb
- $\alpha$ for the acceleration of thumb adduction
- m for the mass of a thumb

As the mass of a thumb is constant, "F" and "$\alpha$" are directly proportional to each other. While the Myograph detects the force "F", the acceleration method detects the acceleration "$\alpha$". In other words, if the changes are expressed as per cent of controls, both method should yield the same degree of changes in the studies of single twitch responses, TOF responses and posttetanic counts. Our study supported this assumption. Thus, the acceleration method gives identical information as the force method and is superior because of its ease of use.

Acknowledgments: The author would like to thank Dr Jørgen Viby-Mogensen for his sientific advice and Mr Ikunosuke Shimura in F.F.V. Japan for supplying the necessary instruments and Miss Kimiko Johjima for her secretarial assistance. A summary of this paper was presented to 9th World Congress of Anesthesiologists, 22nd – 28th of May, 1988, Washington D.C.

(Received May. 6, 1988, accepted for publication Oct. 21, 1988)

## References

1. Jensen, E, Viby-Mogensen J and Bang U.: The Accelograph®: a new neuromuscular transmission monitor. Acta Anaesthesiol Scand 32:49–52, 1988
2. Viby-Mogensen J, Howardy-Hansen P, Chræmmer-Jorgensen B, Ørding H: Posttetanic count (PTC): A new method of evaluating an intense non-depolarizing neuromuscular blockade. Anesthesiology 55:458–461, 1981
3. Ali HH, Savarese JJ: Monitoring of neuromuscular function. Anesthesiology 45:216–249, 1976